Analysis of Computer Network Performance on Communication and Informatics Office of West Sumbawa Regency Using Quality of Service Method

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Abstract

This study aims to determine and analyze network performance with quality of service parameters in realizing good and optimal network performance quality so that it can be adjusted between the efficiency of network needs and the effectiveness of user access at the Communication and Informatics Office of West Sumbawa Regency. The process of accumulating data is obtained by measuring the quality of service parameters using the quality of service method and measuring bandwidth load distribution with the load set at 30 Mbps. The quality of service method on the network, the influence between the variables of network performance quality on the internet connection, and the bandwidth capacity of each user are known. The study results from the quality of service analysis at the Communication and Informatics Service of West Sumbawa Regency entered the excellent category with an average throughput value ranging from 10,320-1,026,454 kbps from the fourth index being in the excellent category. The average packet loss value of 0-1.5% of the third index is in a good category, with the highest value occurring on the fifth day, 1.5%. The average delay value ranges from 7-150 ms, with the highest delay value occurring on the first day due to the user's distance from the remote network access source and queues in dense packet transmission. The average jitter value of 1-12 ms from the third index is in a good category, and the maximum result of the bandwidth value set in size is 9,092,407 bps.

Keywords: Analysis, Bandwidth, Communication and Informatics Office of West Sumbawa Regency, Network Performance, Quality of Service.

1. INTRODUCTION

The Communication and Informatics Service of West Sumbawa Regency is an agency engaged in communication and informatics technology, including telecommunications, communication and dissemination facilities, information, and electronic data processing. The dissemination and processing of data and information by the Communication and Informatics Service of West Sumbawa Regency should be supported by network performance with the availability of effective and adequate internet access so that information can be allocated to the

public optimally. Good network performance can be known for stability by measuring the Quality of Service based on the evaluation of throughput, delay, packet loss, and jitter parameters with standardization from TIPHON [1]. The Quality of Service method is to find out how good the network is and is an attempt to define the characteristics and properties of a service[2]. Quality of Service parameters refers to the management of data traffic and bandwidth allocation based on available throughput to reduce and minimize packet loss, latency, and Jitter on the network so that the performance of the level of speed and reliability of delivering various types of data in the communication can be achieved optimally [3]. The problem faced by the Communication and Informatics Office of West Sumbawa Regency is that with network access that is carried out simultaneously within a certain period, the performance of the internet network becomes slow, along with the increasing load on the internet network. The bandwidth deployment load influenced by throughput with high data mobility flows in this agency is one of the important objects in the research that will be carried out.

The research "Quality of Service (QoS) Analysis on the Internet Network of SMK Negeri 7 Jakarta" explained that the reliability of the internet network could be known how well by using the Quality-of-Service parameter measurement method, namely throughput, delay, packet loss, and Jitter. The tool used for measuring the Quality of Service parameters is Axence Net Tools Pro 5.0. The final result obtained after measuring the Quality of Service is that the Internet network of SMK Negeri 7 Jakarta is included in the medium category with an index value of 2.14[4]. Another study entitled "Analysis of Internet Network Service Quality Wifi.id using Quality of Service parameters" aims to find wifi quality.id internet network, and obtain the magnitude of delay, packet loss, and throughput results in measuring wifi quality.id network. The study's results after analysis obtained the best delay measurement on Jl Gajah TP 1. with a value of 8.5 ms, and the worst on Jl. Parkit TP 4 with a value of 64.8 ms. The best packet loss measurement was found on Jl. Gajah TP 1 with a value of 0.1% and the worst on Jl. Parkit TP 4 with a value of 25.2%. The best throughput measurement is found on Jl. Gajah TP 1 with a value of 93.04% and the worst on Jl. Parkit TP 4 with a value of 45.21% [5].

Another related research on "Comparative Analysis of Quality of Service of Wireless-Based Internet Network on Indihome and First Media Internet Service Provider (ISP) Services" compared the Quality of Service of Internet Service Provider (ISP) service networks between Indihome and First Media using the Quality-of-Service parameter. Based on the average value of the Quality of Service parameter on internet services, Indihome has an average index of 2 which means it is better than First Media internet services which have an average index of 1.67[6]. The purpose of the research entitled "Quality Analysis of

Service Virtual Private Network (VPN) at STMIK STIKOM Indonesia" by I Kadek Susila Satwika, I Made Sukafona, Scientific Journal of Informatics, 2019 is to find out the performance of the VPN network built, it is necessary to analyze the Quality of Service parameters which include delay, Jitter, throughput, and packet loss. From the study results with tests carried out, the QOS results with an index of 3.75, which, if converted to TIPHON standard, the VPN network at STMIK STIKOM Indonesia has satisfactory quality [7]. The study entitled "Quality of Service (QoS) Analysis on the SMA Negeri XYZ Hotspot Network" briefly explains that a good network must pay attention to the quality of services that will be provided to users. This study uses the Quality-of-Service method to measure a network service's performance. The results of the Quality of Service measurement on the SMA Negeri XYZ hotspot network show that the quality of the hotspot network at SMA Negeri XYZ according to TIPHON standards is included in the medium category [8]. There are significant differences from previous studies' research, and previous studies only measured throughput, delay, packet loss, and jitter parameters without any bandwidth measurement, so this study has a more detailed goal direction regarding network performance analysis with the Quality-of-Service method. So, this study aims to find out and analyze network performance with Quality-of-Service parameters and load for the distribution of bandwidth values in realizing good network quality so that it can be adjusted between the efficiency of network needs and the effectiveness of user access at the Communication and Informatics Service of West Sumbawa Regency.

2. METODE

2.1. Research Framework

There are several stages in completing this research, namely: (1) The planning stage of the workflow, (2) the data collection and reference stage, (3) the analysis stage and research results, and (4) the stage of writing the final project report. The following are the stages of research shown in Figure 1.
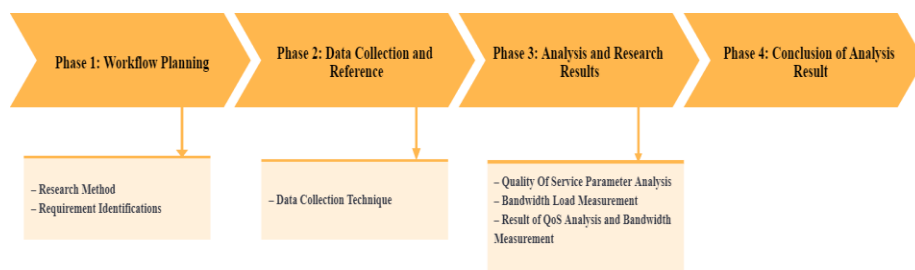

Figure 1. Research Framework.

2.1.1.   Stages of Workflow Planning

The Planning Stage is the initial stage in working on this research. The activities include determining research methods and identifying needs described as follows.

1.   Research Method: To determine network performance in the Communication and Informatics Service of West Sumbawa Regency, researchers will use associative quantitative methods, namely research that asks about the relationship between two or more variables. The relationship used in this study is causal [9]. Data sources are obtained from interviews and observations in the form of capture results, table forms, and the results of calculating Quality of Service parameters. This study aims to determine the influence of variables (x) network performance on variables (y) of internet connection and bandwidth as measured based on Quality-of-Service parameters.

2.   Identification of Needs, As for the identification of needs, researchers will carry out as follows: Laptops with minimal specifications: Intel® Core™ i3-5300U CPU @ 2.30GHz × 4, 8 GB RAM. Operating System; Windows 7 - Windows 10. Software in the form of Wireshark and Axence NetTools 5.0 to measure Quality of Service parameters throughput, delay, packet loss, and jitter values and measure bandwidth load.

2.1.2 Stages of Data Collection and Reference

This stage is the stage that is carried out after the planning stage. After the data is determined, the next stage is to collect the data. The process of collecting data and references is obtained through interviews and site survey observations to collect data and identify the network topology structure used to find out how the mobility flow of using network access and internet connection when used by users.

2.1.3 Stages of Analysis and Research Results

The process carried out at this stage is as follows:

1.   Quality of Service Analysis: At this stage, the Quality-of-Service parameters will be measured using the Wireshark application during working hours at the Communication and Informatics Service of West Sumbawa Regency. Then capture the results of network performance along with the quality of service obtained. Quality of Service monitoring mechanism by retrieving information on the values of the Quality-of-Service parameter from data packet traffic, namely throughput, delay, Jitter, and packet loss.

2.   Measurement of Bandwidth Load, this stage is carried out after knowing the previously measured throughput value. This stage of measuring the bandwidth load distribution will be carried out using the Axences NetTools 5.0 application by sending a packet and overloading it with a certain packet

size, then recapturing the information on the value of the Quality-of-Service parameters of the data packet traffic and collecting and recording data packet traffic information after loading the bandwidth distribution.

3. Quality of Service Analysis and Bandwidth Measurement Results after obtaining the analysis results from the Quality-of-Service parameters and bandwidth measurement results, the data obtained is processed into a table of analysis results.

2.1.4 Conclusion of the Analysis Results

This stage is the final stage in the study to determine the solution after obtaining the analysis of network performance results at the Communication and Informatics Office of West Sumbawa Regency.

2.2 **Network Analysis Performance**

Network performance analysis is a process to determine the relationship between 3 main concepts: resources, delays, and outputs. The objectives of performance analysis include resource analysis and labor analysis. These values are then combined to determine the performance that the system can still handle so that to provide satisfactory service, and network performance must be in good condition[10].

2.3 **Quality of Service**

Quality of Service is a measurement method used to measure a set of performance attributes specified and associated with a service[11]. Quality Of Service is a network mechanism that allows an application or service to operate as expected[12]. Quality of Service is the quality of internet usage satisfaction in services based on delay, packet loss, Jitter, and throughput parameters. Throughput is the effective data transfer rate, which is measured in bps. Throughput is the total number of successful packet arrivals observed at a destination over a given time interval divided by the duration of that time interval[13]. Packet Loss is a parameter that describes a condition that shows the total number of packets lost, and this can occur due to several possibilities, including overload in a network and collisions in the network[14]. Delay is the time it takes for data to travel the distance from origin to destination. Delay can be affected by distance, physical media, congestion, or long processing times[15]. Jitter is a variation of delay. Jitter is affected by traffic load variations and the stack size between packets present in the network. When the Jitter is large while the delay is small, the network performance cannot be said to be bad because the magnitude of the Jitter can be compensated by a small delay value[16]. Here are the parameter values from Quality of Service in Table 1:

Table 1. Parameter Quality of Service.

	Value	Indeks	Category
Throughput	100 kbps	4	Excellent
	75 kbps	3	Good
	50 kbps	2	Fair
	< 25 kbps	1	Poor
Packet Loss	0 %	4	Excellent
	3 %	3	Good
	15 %	2	Fair
	25 %	1	Poor
Delay	< 150 ms	4	Excellent
	150-300 ms	3	Good
	300-450 ms	2	Fair
	> 450 ms	1	Poor
Jitter	0 ms	4	Excellent
	0-75 ms	3	Good
	75-125 ms	2	Fair
	125-225 ms	1	Poor

2.4 Bandwidth

Bandwidth measures the amount of information that can flow from one place to another at a certain time[17]. Bandwidth is the amount of information traffic capacity that can pass through a network connection at a certain period from a communication line. Bandwidth is important to analyze network performance, design new networks, and understand the internet.

2.5 Wireshark

Wireshark is also called a network packet analyzer that captures network packets and strives to display all the information in the packet in as much detail as possible[18]. Wireshark is useful for obtaining information on data packets passing through the network, analyzing network performance, and reading data in real time. The Wireshark app can run on many platforms, such as Linux, Windows, and Mac.

2.6 Axence NetTools

This software is an application to test connectivity on a network by sending data packets to the intended server. From the data sent can be found out the value of bandwidth, delay, and packet loss [19].

3   RESULTS AND DISCUSSION

3.1. Network Topology Structure Analysis

The network topology structure at the Communication and Informatics Office of West Sumbawa Regency after observations using the tree topology model. The topology supports networks that run at scale and can facilitate data and information mobility management. The following overview of the network topology at the Communication and Informatics Office of West Sumbawa Regency is shown in Figure 2.
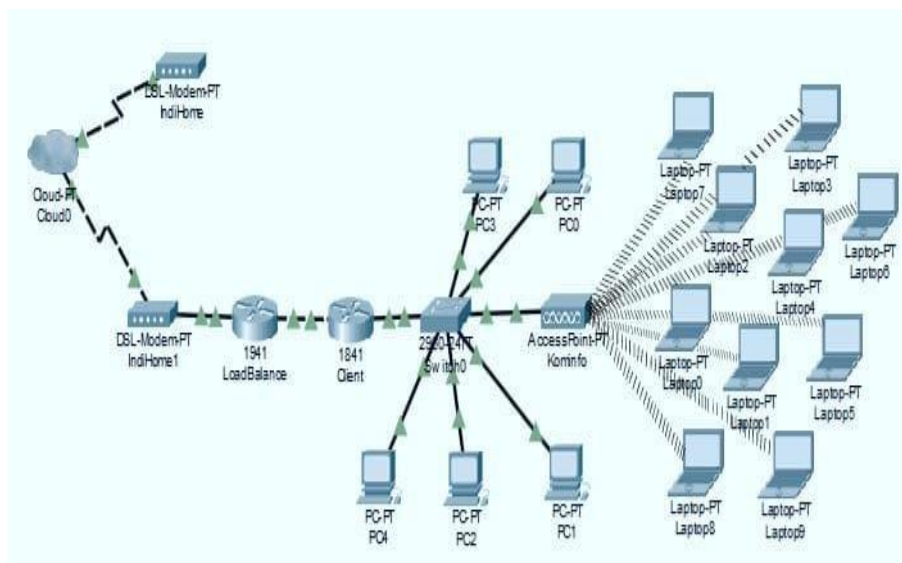

Figure 2. Network Topology Structure.

In the picture of the network structure with the tree topology model above, the network mechanism formed is through the IndiHome1 modem. The internet access point is set up and then divided by the client router through an access point to all users who are in the internet network coverage room at the West Sumbawa Regency Communication and Informatics Office, but without bandwidth restrictions for each user so that the distribution of data mobility that runs is not optimized thoroughly to the user.

3.2. Quality of Service Parameter Analysis

At this stage, the data from the analysis is obtained by measuring the Quality of Service parameters using Wireshark software with scope only in the office room of the Communication and Information Technology Field, which has access to a server room with a varying number of users estimated at ±50 people and a total measurement time of 7 days during working hours. The results of the

measurement of Quality of Service parameters are determined according to the provisions of the index table of the average value of each parameter, namely throughput, packet loss, delay, and Jitter.

3.2.1. Throughput

The following are the results of the Throughput parameter analysis shown in Table 2.

Table 2. throughput parameter analysis results

No	Date	Time	Average (kbps)	Total User	Throughput Category
1	Wednesday, 18/05/2022	10.00-13.00	10.320	23	Excellent
2	Thursday, 19/05/2022	10.00-13.00	52.106	17	Excellent
3	Friday, 20/05/2022	10.00-13.00	13.147	10	Excellent
4	Monday, 23/05/2022	10.00-13.00	188.221	25	Excellent
5	Tuesday, 24/05/2022	10.00-13.00	1.026.454	37	Excellent
6	Wednesday, 25/05/2022	10.00-13.00	33.762	19	Excellent
7	Friday, 27/05/2022	10.00-13.00	16.627	21	Excellent

Based on table 2, the throughput value at the Communication and Informatics Office of the Communication and Informatics Service of West Sumbawa Regency with measurements for seven days during peak hours, which has variations in the number of users obtained throughput value results during the measurement period that has been captured, that the data transfer speed on the

internet network in the Communication and Information Technology field has a very good category with an average value of >100 kbps which ranges from 10,320 kbps – 1,026,454 kbps, With the largest number of users, namely 37 users on the 5th day, it produces a high throughput value of 1,026,454 kbps. At the same time, the smallest throughput value occurs on day 1, which is 10,320 kbps with as many as 23 users, with the highest number of users compared to the second, third, sixth, and seventh days but with the result of a smaller throughput value. Thus, it can be concluded that the number of users does not always influence the measured throughput value but rather is influenced by how long each user receives the total arrival of data packets during the measurement time interval.

3.2.2. Packet Loss

The following are the results of the analysis of packet loss parameters shown in Table 3.

Table 3. Packet Loss Parameter Results

N o	Date	Time	Packet Loss (%)			Total User	Packet Loss Category
			Sent	Los s	Loss (%)		
1	Wednesday, 18/05/ 2022	10.00-13.00	5016	0	0 %	23	Excellent
2	Thursda y, 19/05/ 2022	10.00-13.00	6679	76	1,1 %	17	Good
3	Friday, 20/05/ 2022	10.00-13.00	5065	6	0,1 %	10	Excellent
4	Monday , 23/05/ 2022	10.00-13.00	6295	40	0,6 %	25	Excellent
5	Tuesday , 24/05/ 2022	10.00-13.00	7004	106	1,5 %	37	Good
6	Wednes day,	10.00-13.00	5514	12	0,2 %	19	Excellent

	25/05/2022						
7	Friday, 27/05/2022	10.00-13.00	5596	16	0,3%	21	Excellent

Based on table 3, the packet loss value at the Communication and Information Service of the West Sumbawa Regency Communication and Informatics Office with measurements for seven days during peak hours, which has variations in the number of users obtained packet loss values ranging from 0% - 1.5% and is still in the very good category with the highest average packet loss value occurring on day 5 of 1.5% which has the most user access, namely 37 users. This is caused by the density of traffic flow on the network accessed by as many as 37 users at the same time interval, but the result of the packet loss value is still in an adequate condition even with a large number of users.

3.2.3.　Delay

The following are the results of the Delay parameter analysis shown in Table 4.

Table 4. Delay Parameter Analysis Results

No	Date	Time	Delay (ms)	Average Delay (ms)	Total User	Delay Category
1	Wednesday, 18/05/2022	10.00-13.00	755,888	150, 526	23	Good
2	Thursday, 19/05/2022	10.00-13.00	456,939	68, 424	17	Excellent
3	Friday, 20/05/2022	10.00-13.00	527,359	104, 138	10	Excellent
4	Monday, 23/05/2022	10.00-13.00	133,562	21, 220	25	Excellent
5	Tuesday, 24/05/2022	10.00-13.00	49,8033	7, 111	37	Excellent
6	Wednesday, 25/05/2022	10.00-13.00	369,165	66, 962	19	Excellent

| 7 | Friday, 27/05 /2022 | 10.00-13.00 | 625,754 | 111, 841 | 21 | Excellent |

Based on the table above, the delay value at the Communication and Information Technology Office of the Communication and Informatics Service of West Sumbawa Regency with measurements for seven days during peak hours, which has variations in the number of users obtained the results of delay values with excellent categories that occurred on day 5, namely 7,111 ms with a total of 37 users. And the result of the largest delay value with a good category occurred on day 1, 150 526 ms with 23 users. Thus, it can be concluded that data transfer in and out with various variations of pauses for seven days is caused by several factors, namely the influence of the user's distance from the internet network access source, the closer the user is to the internet access source, the smaller the delay the user gets and can also be caused by the accumulation of queues in the network because the data sent to the user is more than one user.

3.2.4. Jitter

The following are the results of the Jitter parameter analysis shown in Table 5.

Table 5. Jitter Parameter Analysis Results

No	Date	Time	Jitter (ms)	Average Jitter (ms)	Total User	Category Jitter
1	Wednesday, 18/05/2022	10.00-13.00	755, 089	150, 526	23	Poor
2	Thursday, 19/05/2022	10.00-13.00	456, 777	68, 400	17	Good
3	Friday, 20/05/2022	10.00-13.00	527, 459	104, 158	10	Fair
4	Monday, 23/05/2022	10.00-13.00	133, 562	21, 220	25	Good
5	Tuesday, 24/05/2022	10.00-13.00	49, 719	7, 099	37	Good
6	Wednesday, 25/05/2022	10.00-13.00	369, 224	66, 973	19	Good
7	Friday, 27/05/2022	10.00-13.00	626, 366	111, 951	21	Fair

Based on table 5, the jitter value at the Communication and Information Technology Office of the West Sumbawa Regency Communication and Informatics Service with measurements for seven days during peak hours, which has variations in the number of users obtained the results of the jitter value with the smallest jitter value occurring on day 5, which is 7,099 ms with the number

of users as many as 37 users entering the good category on the 3rd index. Meanwhile, the largest jitter value occurred on day 1, 150, 526 ms, with 23 users entering the wrong category on the 1st index. Thus, it is concluded that several factors affect the size of the variability of packet arrival time, namely from internal influences such as route changes and some network congestion that makes data packets sometimes choked or external influences such as poor hardware performance or outdated parts of the network.

3.3 Measurement of Bandwidth Load Size and Quality of Service Analysis

After the Quality of Service analysis is carried out, the next stage is measuring the amount of bandwidth by conducting a brief simulation of the amount of bandwidth load to increase the value of the Quality of Service parameters. At this stage, a simulation was carried out for one day, setting the amount of bandwidth value of 30 Mbps, then tested using the Axence Net tools v5 software. The following is the topology for simulating bandwidth magnitude testing shown in Figure 3.
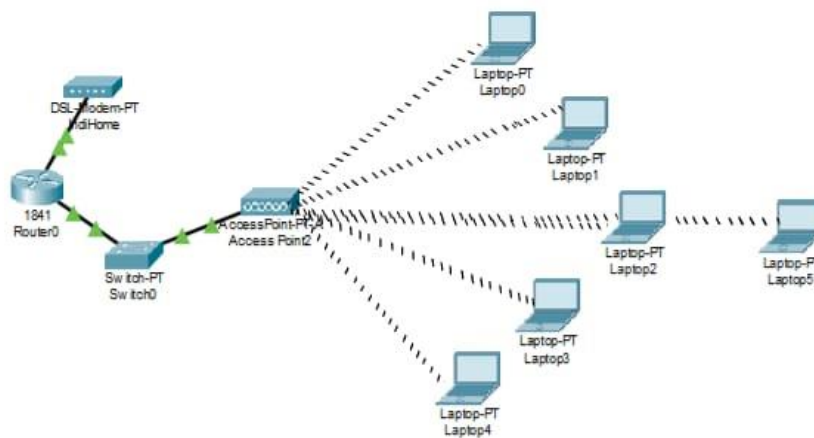

Figure 3. Topology for simulated bandwidth magnitude testing.

In the picture above, the test was carried out through 6 laptops connected to the Kominfo Field wireless network. Five laptops sent data alternately to 1 laptop to find out the value of the bandwidth size after being given the load and the value of the quality of service parameters, namely throughput, packet loss, delay, and Jitter. At this stage, the measurement carried out will produce two analysis results, namely the results of bandwidth analysis that has been set in size, which is tested on five users, and get the results of the analysis of quality of service parameters after the bandwidth load is set.

3.3.1. Results of Measuring the Amount of Bandwidth that has been set

From the measurement through capturing the amount of bandwidth load on the five users, results were obtained such as table 6 as follows:

Table 6. Results of Measuring the Amount of Bandwidth to 5 users

User	Time	Bandwidth(bps)		
		Maximum	**Minimum**	**Average**
Laptop 1		7.017.944	104.440	1.431.780
Laptop 2		7.555.224	41.688	785.294
Laptop 3	30 minutes	7.918.064	34.016	908.129
Laptop 4		6.162.192	6.873.776	9.092.407
Laptop 5		5.615.336	157.904	4.679.541

From the results of table 6, the results of measuring bandwidth after being given a load of 30 Mbps to 5 users can be concluded that the highest value of bandwidth value is 9,092,407 bps with a total maximum bandwidth value ranging from 6 - 7 bps. A high average bandwidth value affects the data transmission speed. It can be seen that the maximum bandwidth value after being given a load of 30 Mbps becomes stable with a range of 6-7 bps so that every user who accesses the internet can carry out the process of sending and receiving data optimally without any distortion, which is a phenomenon caused by varying propagation speeds due to bandwidth differences.

3.3.2. Quality of Service Analysis Results after Bandwidth Loading

The following is a table of capture results from the quality of service parameters shown in Table 7.

Table 7. Quality of Service Measurement Results with bandwidth load set

Quality of Service Parameter	Value	Indeks	Category
Throughput	620 kbps	4	Excellent
Packet Loss	0 %	4	Excellent
Delay	10, 127 ms	4	Excellent
Jitter	9,932 ms	3	Good

From the measurement results in the table above, it can be concluded that the Quality of Service parameters, namely throughput, delay, packet loss, and Jitter, after the regulation of the distribution of load on bandwidth, affects the improvement of network quality at the Office of Communication and Information Technology of the Communication and Informatics Service of West Sumbawa Regency.

4   CONCLUSION

The following conclusions can be drawn based on the results of the Network Performance Analysis research using the Quality of Service method at the Communication and Informatics Service of West Sumbawa Regency.

1. Measuring the Quality of Service on the network proves the influence of variables (x) network performance on variables (y) internet connection and bandwidth. Thus the quality of network performance has been known to facilitate the optimization of network performance and the mobility of data and information to users.

2. The results of the Quality of Service Analysis at the Communication and Informatics Service of West Sumbawa Regency entered the very good category, with an average throughput value ranging from 10,320 kbps – 1,026,454 kbps from the 4th index with the provision that the value was ≥100 kbps and was in the very good category. The average packet loss value is 0-1.5% of the 3rd index with the provision of a < value of 3% and is in the good category with the highest value occurring on the 5th day, which is 1.5% due to a large number of users, namely 37 users. The average delay value ranges from 7-150 ms, with the highest delay value occurring on day one caused by the user's distance from the internet network access source that is too far and the queue in the transmission of packets being dense. The average jitter value of 1-12 ms from the 3rd index provided that the range value between 7 – 150 ms with the largest jitter value occurring on day 1 of 150.526 ms and is in a good category then the result of the bandwidth value that has been set in size with an average maximum result of 9,092,407 bps.

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